1. Let A and B be matrices of order 3×3. If $|A| = \dfrac{1}{2\sqrt{2}}$ and $|B| = \dfrac{1}{729}$, then what is the value of $|2B(adj(3A))|$?

(a) 27

(b) $\dfrac{27}{2\sqrt{2}}$

(c) $\dfrac{27}{2}$

(d) 1

11. Consider the following statements in respect of two non-singular matrices A and B of the same order n :

1. $adj(AB) = (adjA)(adjB)$

2. $adj(AB) = adj(BA)$

3. $(AB)adj(AB) - |AB|I_n$ is a null matrix of order n

How many of the above statements are correct ?

(a) None

(b) Only one statement

(c) Only two statements

(d) All three statements

12. Consider the following statements in respect of a non-singular matrix A of order n :

1. $A(adjA^T) = A(adjA)^T$

2. If $A^2 = A$, then A is identity matrix of order n

3. If $A^3 = A$, then A is identity matrix of order n

Which of the statements given above are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

16. Consider the following statements in respect of a skew-symmetric matrix A of order 3 :

    1. All diagonal elements are zero.

    2. The sum of all the diagonal elements of the matrix is zero.

    3. A is orthogonal matrix.

Which of the statements given above are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

19. For what value of n is the determinant

$$\begin{vmatrix} C(9,4) & C(9,3) & C(10,n-2) \\ C(11,6) & C(11,5) & C(12,n) \\ C(m,7) & C(m,6) & C(m+1,n+1) \end{vmatrix} = 0$$

for every $m > n$?

(a) 4

(b) 5

(c) 6

(d) 7

26. If a, b, c are in AP; b, c, d are in GP; c, d, e are in HP, then which of the following is/are correct ?

   1. a, c and e are in GP

   2. $\dfrac{1}{a}$, $\dfrac{1}{c}$, $\dfrac{1}{e}$ are in GP

Select the correct answer using the code given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

29. If $A = \begin{bmatrix} \sin 2\theta & 2\sin^2\theta - 1 & 0 \\ \cos 2\theta & 2\sin\theta\cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then

which of the following statements is/are correct ?

1. $A^{-1} = adj A$

2. A is skew-symmetric matrix

3. $A^{-1} = A^T$

Select the correct answer using the code given below :

(a) 1 only

(b) 1 and 2

(c) 1 and 3

(d) 2 and 3

74. What is $\int_{-1}^{1} (3\sin x - \sin 3x)\cos^2 x \, dx$ equal to ?

(a) $-\dfrac{1}{4}$

(b) 0

(c) $\dfrac{1}{2}$

(d) $\dfrac{1}{4}$

Let $\varphi(a) = \int_{a}^{a+100\pi} |\sin x| \, dx$

89. What is $\varphi(a)$ equal to ?

(a) 0

(b) a

(c) $100a$

(d) 200

90. What is $\varphi'(a)$ equal to ?

(a) 0

(b) π

(c) 100

(d) 200

1. If ω is a non-real cube root of 1, then what is the value of $\left| \dfrac{1-\omega}{\omega+\omega^2} \right|$?

(a) $\sqrt{3}$

(b) $\sqrt{2}$

(c) 1

(d) $\dfrac{4}{\sqrt{3}}$

4. Let A be a matrix of order 3×3 and $|A|=4$. If $|2\,\mathrm{adj}(3A)|=2^\alpha 3^\beta$, then what is the value of $(\alpha+\beta)$?

(a) 12

(b) 13

6. Let A and B be symmetric matrices of same order, then which one of the following is correct regarding $(AB - BA)$?

1. Its diagonal entries are equal but nonzero

2. The sum of its non-diagonal entries is zero

Select the correct answer using the code given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

13. If a, b, c are in AP, then what is

$$\begin{vmatrix} x+1 & x+2 & x+3 \\ x+2 & x+3 & x+4 \\ x+a & x+b & x+3 \end{vmatrix} \text{ equal to ?}$$

(a) −1

(b) 0

(c) 1

(d) 2

15. If $2^{\frac{1}{c}}$, $2^{\frac{b}{ac}}$, $2^{\frac{1}{a}}$ are in GP, then which one of the following is correct ?

(a) a, b, c are in AP

(b) a, b, c are in GP

(c) a, b, c are in HP

(d) ab, bc, ca are in AP

22. A mapping $f : A \to B$ defined as
$f(x) = \dfrac{2x+3}{3x+5}$, $x \in A$. If f is to be onto, then what are A and B equal to ?

2

(a) $A = R\backslash\{-\frac{5}{3}\}$ and $B = R\backslash\{-\frac{2}{3}\}$

(b) $A = R$ and $B = R\backslash\{-\frac{5}{3}\}$

(c) $A = R\backslash\{-\frac{3}{2}\}$ and $B = R\backslash\{0\}$

(d) $A = R\backslash\{-\frac{5}{3}\}$ and $B = R\backslash\{\frac{2}{3}\}$

27. Consider the following statements for a fixed natural number n :

1. $C(n, r)$ is greatest if $n = 2r$

2. $C(n, r)$ is greatest if $n = 2r - 1$ and $n = 2r + 1$

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

$P(x, y)$ is any point on the ellipse $x^2 + 4y^2 = 1$. Let E, F be the foci of the ellipse.

57. What is $PE + PF$ equal to ?

(a) 1

(b) 2

(c) 3

(d) 4

Let $A(1, -1, 2)$ and $B(2, 1, -1)$ be the end points of the diameter of the sphere
$$x^2 + y^2 + z^2 + 2ux + 2vy + 2wz - 1 = 0.$$

61. What is $u + v + w$ equal to ?

    (a) -2

    (b) -1

    (c) 1

    (d) 2

62. If $P(x, y, z)$ is any point on the sphere, then what is $PA^2 + PB^2$ equal to ?

    (a) 15

    (b) 14

    (c) 13

    (d) $6 \cdot 5$

1. If $z\bar{z} = |z + \bar{z}|$, where $z = x + iy$, $i = \sqrt{-1}$, then the locus of z is a pair of :

(a) straight lines

(b) rectangular hyperbolas

(c) parabolas

(d) circles

5. If A, B and C are square matrices of order 3 and $\det(BC) = 2\det(A)$, then what is the value of $\det(2A^{-1}BC)$?

(a)   16

(b)   8

(c)   4

(d)   2

Let A be a skew-symmetric matrix of order 3.

What is the value of

$$\det(4A^4) - \det(3A^3) + \det(2A^2) - \det(A) + \det(-I)$$

where I is the identity matrix of order 3 ?

(a)   – 1

(b)   0

(c)   1

(d)   2

8. If $A = \begin{bmatrix} 0 & 3 & 4 \\ -3 & 0 & 5 \\ -4 & -5 & 0 \end{bmatrix}$, then which one of the following statements is correct ?

(a) A^2 is symmetric matrix with $\det(A^2) = 0$.

(b) A^2 is symmetric matrix with $\det(A^2) \neq 0$.

(c). A^2 is skew-symmetric matrix with $\det(A^2) = 0$.

(d) A^2 is skew-symmetric matrix with $\det(A^2) \neq 0$.

If $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, then which of the following statements are correct ?

1. A^n will always be singular for any positive integer n.

2. A^n will always be a diagonal matrix for any positive integer n.

3. A^n will always be a symmetric matrix for any positive integer n.

Select the correct answer using the code given below :

(a)   1 and 2 only

(b)   2 and 3 only

(c)   1 and 3 only

(d)   1, 2 and 3

17. If A = $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 3 & 0 \\ 1 & 0 & 1 \end{bmatrix}$, then what is the value of det[adj(adjA)] ?

(a)   5

(b)   25

(c)   125

(d)   625

If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then what is

$23A^3 - 19A^2 - 4A$ equal to ?

(a)   Null matrix of order 3

(b)   Identity matrix of order 3

(c) $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

(d) $\begin{bmatrix} 7 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 7 \end{bmatrix}$

19. The value of the determinant of a matrix A of order 3 is 3. If C is the matrix of cofactors of the matrix A, then what is the value of determinant of C^2 ?

(a)   3

(b)   9

(c)   81

(d)   729

20. If $A_k = \begin{bmatrix} k-1 & k \\ k-2 & k+1 \end{bmatrix}$, then what is $\det(A_1) + \det(A_2) + \det(A_3) + \ldots + \det(A_{100})$ equal to ?

(a)   100

(b)   1000

(c)   9900

(d)   10000

6. If $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & \sin\theta & -\cos\theta \end{pmatrix}$, then which of the following are correct ?

1. $A + adjA$ is a null matrix

2. $A^{-1} + adjA$ is a null matrix

3. $A - A^{-1}$ is a null matrix

Select the correct answer using the code given below :

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Consider the following for the next **three** (03) items that follow :

$$\text{Let } A = \begin{pmatrix} 0 & \sin^2\theta & \cos^2\theta \\ \cos^2\theta & 0 & \sin^2\theta \\ \sin^2\theta & \cos^2\theta & 0 \end{pmatrix} \text{ and}$$

$A = P + Q$ where P is symmetric matrix and Q is skew-symmetric matrix.

37. What is P equal to ?

(a) $\begin{pmatrix} 0 & 1/2 & 1/2 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/2 & 0 \end{pmatrix}$

(b) $\begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$

(c) $\cos 2\theta \begin{pmatrix} 0 & -1 & 1 \\ 1 & 0 & -1 \\ -1 & 1 & 0 \end{pmatrix}$

(d) $\cos 2\theta \begin{pmatrix} 0 & -1/2 & 1/2 \\ 1/2 & 0 & -1/2 \\ -1/2 & 1/2 & 0 \end{pmatrix}$

38. What is Q equal to ?

(a) $\begin{pmatrix} 0 & 1/2 & 1/2 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/2 & 0 \end{pmatrix}$

(b) $\begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$

(c) $\cos 2\theta \begin{pmatrix} 0 & -1 & 1 \\ 1 & 0 & -1 \\ -1 & 1 & 0 \end{pmatrix}$

(d) $\cos 2\theta \begin{pmatrix} 0 & -1/2 & 1/2 \\ 1/2 & 0 & -1/2 \\ -1/2 & 1/2 & 0 \end{pmatrix}$

3. Consider the following statements :

1. The degree of the differential equation $\frac{dy}{dx} + \cos\left(\frac{dy}{dx}\right) = 0$ is 1.

2. The order of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \cos\left(\frac{dy}{dx}\right) = 0$ is 2.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

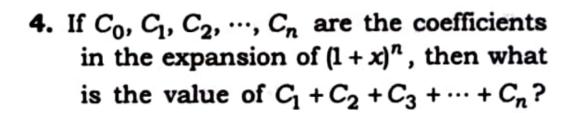**3.** If Δ is the value of the determinant

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

then what is the value of the following determinant?

$$\begin{vmatrix} pa_1 & b_1 & qc_1 \\ pa_2 & b_2 & qc_2 \\ pa_3 & b_3 & qc_3 \end{vmatrix}$$

$(p \neq 0 \text{ or } 1, \ q \neq 0 \text{ or } 1)$

(a) $p\Delta$

(b) $q\Delta$

(c) $(p+q)\Delta$

(d) $pq\Delta$

4. If $C_0, C_1, C_2, \cdots, C_n$ are the coefficients in the expansion of $(1+x)^n$, then what is the value of $C_1 + C_2 + C_3 + \cdots + C_n$?

(a) 2^n

(b) $2^n - 1$

(c) 2^{n-1}

(d) $2^n - 2$

5. If $a + b + c = 4$ and $ab + bc + ca = 0$, then what is the value of the following determinant?

$$\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$$

(a) 32

(b) −64

(c) −128

(d) 64

11. If A and B are two matrices such that AB is of order $n \times n$, then which one of the following is correct?

(a) A and B should be square matrices of same order.

(b) Either A or B should be a square matrix.

(c) Both A and B should be of same order.

(d) Orders of A and B need not be the same.

14. If A and B are square matrices of order 2 such that $\det(AB) = \det(BA)$, then which one of the following is correct?

(a) A must be a unit matrix.

(b) B must be a unit matrix.

(c) Both A and B must be unit matrices.

(d) A and B need not be unit matrices.

19. What is the value of the following?

$$\tan 31° \tan 33° \tan 35° \cdots \tan 57° \tan 59°$$

(a) -1

(b) 0

(c) 1

(d) 2

30. If $3\cos\theta = 4\sin\theta$, then what is the value of $\tan(45° + \theta)$?

(a) 10

(b) 7

(c) $\dfrac{7}{2}$

(d) $\dfrac{7}{4}$